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FORM AND FORMAL THOUGHT.

The Fundamental Problem of Philosophy

BY

DR. PAUL CARUS.

EXCERPT FROM THE WORK "FUNDAMENTAL PROBLEMS," PUBLISHED SIMULTANEOUSLY WITH THE APPEARANCE OF THIS PAMPHLET.

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FORM AND FORMAL THOUGHT.

I.

KANT'S CRITIQUE OF PURE REASON.

In the introduction to his "Critique of Pure Reason," Immanuel Kant proposes the question: How are synthetical judgments *a priori* possible? On the solution of this problem the whole structure of his philosophy rests, which he characterizes as *Transcendental Idealism.*

'A priori' means 'beforehand,' and its opposite 'a posteriori' means 'afterwards.' To know something a priori means to know something before any experience thereof has been had. When we know that the specific gravity of ebony is greater than that of water, we can declare a priori, that ebony will not float, but sink to the bottom (the physical law being also considered known). We can even know it *before* the experiment is made. The experiment will afterwards, *i. e.* a posteriori, verify our knowledge.

This is the general meaning of the terms 'a priori' and 'a posteriori.' But Kant uses the words in a more limited sense.

In Kant's language the term 'experience' is employed to signify sense-perception. It is not exactly limited to that meaning throughout, but certainly it is always used in opposition to non-sensory or

mere formal knowledge. That which produces experience, and which as a reality outside of us and independent of our sensation corresponds to sensory impressions, Kant calls 'matter.' Therefore, we have knowledge of the existence of matter and its different properties 'a posteriori,' or from experience, *i. e.* from sense-perception only.

There is another kind of knowledge, however, which is not sense-knowledge, but formal knowledge. Formal knowledge can be gained by abstraction. The form of things, such as globes, cubes, statues, and other bodies, can be abstracted from their material reality. We can, for instance, think away all things in the world. (We abstract from their material existence.) What is left is 'empty space'; and this conception of pure space is the postulate of a science that is called mathematics. We can abstract, also, from all processes which take place in the world; what is left is the idea of duration only; it is 'empty time,' in which these processes might have taken place. The conception of time, pure and simple, can be conceived as a progress through empty units without reference to real phenomena. Such empty units are called numbers, and by adding one unit to another, we start a process that is known as counting. Counting is the basis of arithmetic. If, again, we abstract from the substance of our thoughts, the mere forms of thought remain, which, treated as a science, are called formal logic.

It must be remarked in passing that Kant calls space and time 'pure perceptions' (*reine Anschauungen*), while the categories are treated as 'pure conceptions' (*reine Verstandesbegriffe*). This distinction is justifiable for certain purposes, and should not be slurred over by commentators of Kant's philosophy.

However, our present purpose is not to explain or popularize the Critique of Pure Reason, but to use its more prominent ideas for propounding our own views which grew out of a study of Kant's Transcendentalism. We may add that every perception, as soon as it is named and clearly defined, becomes a conception. Space can be the basis of mathematics, and time of arithmetic only when both have grown to be clear conceptions.

Formal knowledge is called by Kant a priori, because, if any truth of these formal sciences is established, it will be known to be true for all possible cases of experience, even before the experiments have been made. The rules of mathematics, of arithmetic, and logic, possess rigid necessity and absolute universality. They are the condition of all scientific investigation; for rigidity and universality (*Nothwendigkeit und Allgemeinheit*) in experimental sciences can be realized only through the assistance of the formal sciences. Astronomy and chemistry, for instance, have become sciences only by the application of mathematics and arithmetic; and where can any kind of science be found that could dispense with logic?

A priori, as used in the limited sense by Kant, is purely formal knowledge, while a posteriori is identical with experience. Marks of a priori truths are, according to Kant, absolute rigidity and universality (*Nothwendigkeit und Allgemeinheit*).

Kant has been represented as a philosopher who teaches by his doctrine of the a priori, that man has innate ideas ready in his consciousness. Pure reason, he was supposed to believe, wells up in us as some mysterious power coming from trandescendent and most probably supernatural regions. This is absolutely

unfounded, as can be learned from the very first sentence in the introduction to his "Critique of Pure Reason":

"*That all our knowledge begins with experience there can be no doubt.* For how is it possible that the faculty of cognition should be awakened into exercise otherwise than by means of objects which affect our senses, and partly of themselves produce representations, partly rouse our powers of understanding into activity, to compare, to connect, or to separate these, and so to convert the raw material of our sensory impressions into a knowledge of objects, which is called experience?* *In respect of time, therefore, no knowledge of ours is antecedent to experience, but begins with it.*"

In order to show that formal knowledge must be distinguished from sensory experience, Kant continues:

"But, though all our knowledge begins with experience, it by no means follows, that all arises out of experience.† For, on the contrary, it is quite possible that our empirical knowledge is a compound of that which we receive through impressions, and that which the faculty of cognition supplies from itself (sensory impressions giving merely the occasion), an addition which we cannot distinguish from the original element given by sense, till long practice has made us attentive to, and skillful in, separating it. It is, therefore, a question which requires close investigation, and is not to be answered at first sight—whether there exists a knowledge altogether independent of experience, and even of all sensory impressions? Knowledge of this kind is called a priori, in contradistinction to empirical knowledge, which has its sources a posteriori, that is, in experience."

Formal knowledge is independent of sensory experience in so far as we purposely exclude all sensory experience. But, after all, inasmuch as sensory experience is the beginning of all knowledge, a posteriori as well as a priori, to that extent formal

* The word 'experience' is here used in the popular acceptation, being taken as the result of sensory impressions fashioned by pure thought.

† Here the word is used in the limited sense, as sensory experience.

knowledge is dependent upon sensory experience (as Kant emphatically declares). Experience is antecedent in time, and from it alone formal knowledge can originate, which—not until a certain height of mental development has been reached — will be separated from the raw material of sensory impressions.

Kant, using the word experience in the limited sense of sensory experience, declares that investigation must go beyond experience in order to find the laws of formal knowledge, or pure thought. He, therefore, called all formal knowledge transcendental, and speaks of transcendental logic, transcendental dialectic, transcendental mathematics, and transcendental arithmetic.

Transcendental is by no means transcendent. Transcendent means unknowable, or what transcends knowledge; transcendental, according to Kant, means what transcends experience. It is not unknowable, but, on the contrary, the basis of all knowledge, and the transcendental sciences treat such subjects as demand (if treated with accuracy) axiomatic certainty. The mysterious has no place in the realms of the transcendental.

The question 'How are synthetical judgments a priori possible?' is to the same purpose as another question of Kant's, propounded in his Prolegomena, § 36, where he asks: "How is nature possible?" When Kant speaks of nature, he refers to our conception of reality, in so far as it is, or can become, the object of science representing the cosmical order of nature. We do not now intend to enter into the details of the problem, as to how far we agree with the sage of Königsberg, and how far we do not agree. But it seems necessary to point out the importance of the

problem, on the solution of which the possibility of scientific knowledge depends.

The faculty of thinking *in abstracto* is called reason; and reason (which on earth man alone possesses by virtue of language) can become the basis of science, if by a critical method fallacies and vagaries of reason are prevented. Kant says in the introduction to his "Critique of Pure Reason:"

> "The critique of reason leads at last, naturally and necessarily, to science; and, on the other hand, the dogmatical use of reason without criticism leads to groundless assertions, against which others equally specious can always be set, thus ending unavoidably in skepticism."

The whole book is devoted to this critique. It shows that pure reason (formal thought) is limited to formal truths only and cannot contain revelations as to the substantial (the sensory or material) contents of our conceptions. This should have been self-evident; but as a matter of fact, philosophers before and even after Kant have most confidently asserted much about God and the world, the human soul, innate ideas, and other things, while their whole reasoning rested upon unwarranted a priori arguments. Such philosophers Kant calls dogmatical. Wolf (1679–1754), who had most methodically systematized the metaphysical doctrines of his time, is the most representative dogmatic philosopher.

If we compare our cognition to building material, Kant said, our transcendental knowledge has been employed by dogmatical philosophers for erecting a lofty dome that should reach to Heaven. For this purpose the "Critique of Pure Reason" has found the materials insufficient. Nevertheless, our transcendental cognition is most valuable; certainly it is unfit for the

airy castles of supernatural systems; but if employed for its proper purpose, Kant continues, "it very well suffices for a mansion here on earth spacious enough for all our purposes and high enough to enable us to survey the level plain of experience."

Formal cognitions, or conceptions a priori, are of themselves "empty;" and sensory impressions of themselves are "blind." If we had only unconnected sensory impressions, we would be worse off than the lowest animalcula or even plants, and the materials of our experience received through our sensory organs would be of no avail. Our formal cognitions furnish the mortar, as it were, of a synthetic method which will enable us to arrange sensory impressions in comprehensively arranged systems. Formal cognition and sensory experience, therefore, are the warp and woof of scientific knowledge. The warp as well as the woof, each by itself, consists of single threads, but in their combination they will furnish a well-woven fabric.

If a philosopher limits his method to sensory experience alone, he will never attain scientific certainty; he can never make definite and positive statements, but will only propose *opinions* which may be overturned on the slightest occasion. Such a one-sided empirical, or naturalistic, philosopher would be guilty of the opposite error of the dogmatist, and while the dogmatist ultimately must arrive at futile assertions, the empiricist's mere opinions must lead directly to skepticism. As the representative philosopher of skepticism, Kant mentions David Hume. David Hume does not recognize the difference between formal knowledge and sensory experience. To him, therefore, all knowledge consists of single, unconnected threads of knowledge.

On the last two pages of Kant's "Critique of Pure Reason," we read the following passages:

"We may divide the methods at present employed in the field "of enquiry into the naturalistic and the scientistic."

'Naturalistic' here means what is commonly called "common sense philosophy," which, repudiating all speculation, does not feel the need of a critical method. Kant continues:

"The naturalist of pure reason lays it down as his principle, "that common reason, without the aid of science—which he calls "sound reason, or common sense—can give a more satisfactory "answer to the most important questions of metaphysics than spec- "ulation is able to do. He must maintain, therefore, that we can "determine the content and circumference of the moon more "certainly by the naked eye than by the aid of mathematical rea- "soning. But this system is mere misology [contempt of rational "thought] reduced to principles; and, what is the most absurd "thing in this doctrine, the neglect of all scientific means is paraded "as a peculiar method of extending our cognition. As regards "those who are naturalists because they know no better, they are "certainly not to be blamed. They follow common sense, with- "out parading their ignorance as a method which is to teach us the "wonderful secret, how we are to find the truth which lies at the "bottom of the well of Democritus."

'Scientistic' denotes here the method of one-sided scientists. The original German text reads *scientifisch*, which has been coined by Kant in opposition to *wissenshaftslich*, *i. e.* scientific in its usual sense. This scientistic, or one-sided scientific, method lacks critique; it does not distinguish between formal and sensory (between a priori and a posteriori), and must either undervalue the importance of formal cognition, by not properly employing it as a synthetic principle, or overvalue the importance of formal cognition by attributing to it the power of a supernatural revelation. Kant continues, and concludes his "Critique of Pure Reason" as follows:

"As regards those who wish to pursue a scientistic method, they "have now the choice of following either the dogmatical or the 'skeptical, while they are bound never to desert the systematic "mode of procedure. When I mention, in relation to the former, "the celebrated Wolf, and as regards the latter, David Hume, I "may leave, in accordance with my present intention, all others "unnamed.

"The critical path alone is still open. If my reader has "been kind and patient enough to accompany me on this hith- "erto untraveled route, he can now judge whether, if he and oth- "ers will contribute their exertions towards making this narrow "foot-path a high-road of thought, that, which many centuries "have failed to accomplish, may not be executed before the close "of the present—namely, to bring Reason to perfect contentment "in regard to that which has always, but without permanent re- "sults, occupied her powers and engaged her ardent desire for "knowledge."

II.

THE ORIGIN OF THE 'A PRIORI.'

KANT answers the question 'How are synthetic judgments a priori possible?' by showing that such synthetic judgments undoubtedly exist.

A synthetic judgment is different from an analytic judgment. An analytic judgment merely analyses knowledge and contains nothing but an explanation or elucidation of what, in an involved form, we have known before, but a synthetic judgment really amplifies our knowledge; it adds to the stock of our knowledge something new, which we have not known before. In proving that the exterior angle of a triangle is equal to the sum of the two opposite interior angles of the same, we amplify our knowledge of the triangle by mere ratiocination, a priori. Kant uses even a simpler instance. The judgment $7 + 5 = 12$ is not analytic

but synthetic. The concept twelve is neither contained in seven nor in five, but is something entirely new.

Kant leaves the subject here and is satisfied with the fact *that* synthetic judgments a priori are possible. He might have ventured a step further by proposing another question: 'What is the origin of the a priori?' Only by answering this question could he have shown, *how* synthetic judgments a priori are possible. This he did not do, and the omission has produced great confusion among German, French, and English thinkers.

The word 'a priori' is undoubtedly an old-fashioned and awkward expression, which has not yet lost the savor of 'innate ideas.' It was readily accepted in England by philosophers of a theological bias who were little aware of the dangerous properties concealed in this Kantian idea. It sounds so scholarly Latin, almost ecclesiastical; for it is an expression handed down from mediæval times. But when they drew this clumsy wooden horse within the walls of their dogmatic stronghold, they unwittingly admitted an army of bellicose warriors—Kant's critical thoughts—who are sure to conquer and destroy the citadel of dualistic orthodoxy.

"The old fashioned a priori in science, in morals, and religion," a reviewer in *Science** somewhere remarks "used to be represented as an arrogant and intolerant thing, mysterious in its manner of speech, violent and dogmatic in the defense of its own claims. The English Empiricists used to hate this aristocratic a priori and they shrewdly suspected it to be a humbug. What they gave us in its place, however, was a

* Science. Vol. V, p. 202.

vague and unphilosophic doctrine of science that you could only seem to understand so long as you did not examine into its meaning." J. S. Mill's philosophy moved in a circle. "He had founded all inductive interpretation of nature on the causal principle and the causal principle again on an inductive interpretation of nature."

Kant, as we have stated, calls the a priori truths 'formal knowledge,' and this indicates that the general postulates of the transcendental sciences, the axiomatic conceptions from which they start, are abstracted from reality by thinking away, as it were, their material existence, which is represented in our sensory impressions. Kant suggests this conception of the a priori, but he nowhere pronounces it. On the contrary, he makes statements which may be taken to exclude this interpretation of his conception.

According to our view, form is a property of reality as well as of our cognition. Formless matter does not exist. Form and matter, as they exist in reality, are inseparable. What is called formless matter is either uniform or lacking that kind of form which, in our opinion or according to our wishes, it should have. Knowledge also in its primitive shape, when it is, so to say, natural and crude, is an intimate combination of sense-perceptions and formal cognition. The sense-perceptions are the real substance of knowledge, while formal cognition is the principle which arranges and systematizes sense-experience.

As soon as a living being develops the ability to think *in abstracto*, a state which is attained by means of language, he can think of different qualities independent of things. He can think of whiteness, of greatness, of smallness, of courage, and of cowardice. And

soon after that, he will be also able to think one, two, three, four, five units *in abstracto* without the assistance of his fingers; he will count. Counting is a most important step in the development of humanity, for it is the first purely formal thought. It abstracts from the objects counted and refers exclusively to the unit numbers which then may be employed for any kind of things.

Physiologically considered the growth of abstract and formal ideas must have developed in the following way:

Irritations in the amœba can only produce vague feelings. Light and darkness, heat and cold, moisture and aridity, abundance and scarcity of food, exercise a certain influence upon the animalcule; they act upon it in a certain way and produce more or less favorable or unfavorable effects in the living substance which may ultimately result in reactions of some kind. In higher animals irritations are reacted upon differently in different organs. Sensitiveness has been differentiated, and a ray of light is perceived on the nerves of the skin as warmth and in those of the eye as light.

The same process of differentiation and specialization takes place in the brain. If a horse is seen, its image appears on the retina of the eye, whence the irritation is transmitted through the optic nerve to the interior parts of the brain. There it is perceived as a horse. According to Hering* and other physiologists, there is no doubt but that every new perception of a horse is registered on the same spot in the brain as previously. Every single brain-cell has a memory of its own, which makes it more fit to be irritated by

*See Ewald Hering: Memory as a General Function of Organized Matter. THE OPEN COURT, p. 143.

that perception to which it has adapted itself. Thus, the conception of a horse is the sum total of all percepts of a horse. It is, as Mr. Hegeler* most appropriately expresses it, like a composite photograph. The common features of a certain group of same things are preserved, while the individual traits become blurred and are lost sight of.

Thus the many varying images of the eye, and all sensory impressions, as well as motory exertions, are registered somewhere in the brain, each kind in its place. The special memory of the different fibres and cells naturally arranges all percepts and concepts in a proper order. Moreover, a repeated simultaneousness of different sensations which are produced by same causes in different sense-organs, produces associations between certain percepts. We think of the rose and at the same time of its smell and its color. We see a bird and think of his song, and the dog who sees the whip feels at once in his recollection the pain caused by its lash.

Horses have been perceived which are different in size, and color, and temper, etc. These differences are occasionally of importance. A horse may attract attention because it is as white as snow. The horse is perceived and also its whiteness. Thus a new concept is created, the concept of a quality which does

*Mr. E. C. Hegeler, in his essay, "The Soul," (see THE OPEN COURT, p. 393) says:

"If an abstraction is made, many things having something in common are put together, and what they have in common is specified in words. It is then forgotten that what they do not have in common disappears in the generalization. The same takes place in Galton's composite photographs of the members of a family. Only that remains of the several faces what they have in common. This implies that the composite photograph is entirely contained in each of the single photographs of each member, each is the complete composite with additions. So in reality the composite photograph is an abstraction—a part—of each of the single photographs."

not correspond to, but has been abstracted from, concrete objects. White roses, white snow, white stones (as lime or chalk), and white horses have been perceived, and the percept of 'whiteness' is produced, to which again a special province of the brain must be ascribed, which of course must be connected by nerve fibres with all white things, more so with things that are always white than with those that appear so only occasionally. The psychical connection of such concepts is called association.

Suppose we are in a library where the books are well arranged by a number of librarians who have different but each one his own special interests. Many books are being constantly delivered. There are books about horses, and dogs, and flowers, and stones, etc., etc. Every librarian takes the books of that subject with whose study he is specially engaged and places it in his alcove. The library would be in the best order, and yet so long as the different alcoves were not named, most of its treasures would be inaccessible for many most important purposes. Such is the arrangement in animal brains. A dog knows what a cat is. Every new perception of a cat awakens in his mind with more or less vividness all the many previous percepts of a cat with their different associations, mostly memories of pursuit, perhaps also of resistance and combat. But all these memories are single percepts. They have not yet coalesced into a unitary and clear conception of catdom. If the sum total of the cat-percepts in his memory is to be called a conception, it is certainly a very imperfect kind of conception. A conception becomes distinct only by being named. This is the truth which has been so splendidly elucidated by our best philological authori-

ties, namely, that thought (the abstract thought of reasonable beings) is only possible by the help of language. Man thinks because he speaks. The name of a thing is, as it were, a string tied around all the many percepts of that thing, thus comprehending them all in one concept. Concept is derived from *con* and *capio* and means, according to its etymology, a taking or grasping together, a gathering into and holding in one.

The act of naming is therefore an enormous economy in mental activity; it is the mechanical means by which abstract ideas or generalizations are formed; and the faculty of thinking *in abstracto* is called reason. Reason, therefore, in its elementary origin, is abstracting and combining. Abstracting is a kind of separation. We separate the quality of white from white objects and combine all the different white-sensations into one concept by the name of 'whiteness.' *Both* processes, that of separation and of combination, are essential features of reason; but they are *the* essential features, and all functions of reason can be reduced to these two processes.*

Our brain is like a workshop in full and unceasing activity. In its operation, we must distinguish three things:

*F. Max Müller defines Reason as "addition and subtraction." We have repeatedly given our full assent to the great philologist's views with the remark, that we should substitute for "addition and subtraction" the terms used above, *i. e.*, "combination and separation." The terms "addition and subtraction" are confined to arithmetic; and to our mind they are different from "combination and separation" in so far as "subtraction" is used of units that are taken away from other equal units, while "separation" takes a part from something that appeared as a unit (an integral whole) before the separation. Similarly an addition sums up units of the same kind (or at least those which for the purpose of addition are considered as being of the same kind) into a larger number, while a combination unites parts into one consolidated whole. We believe that there is no substantial difference between Prof. Max Müller's view and our own.

1. The activity which is called life; it is a special kind of energy. Its presence makes itself felt as motion, which is a change of place and could be, if all details were known, mechanically expressed.

2. The material of which the whole workshop of the brain consists, and which is used to keep it in working order; viz., the matter which is constantly combining and decomposing in the protoplasm of the brain-substance.

3. The form in which life operates in the nervous substance. Every brain-cell has a special form, the groups of cells are arranged in special forms and the whole system of the different cerebral organs is built up in a special form.

We distinguish these three things, but in reality they are inseparably united. If our percepts and concepts are to be physically considered, they should not be represented as the activity only of the brain, nor as brain-substance, nor as their mere form. They are activity, and matter, and form united; being a special form of the activity in brain-substance. It goes without saying that the form of a special energy depends upon the form of that substance in which the process takes place. The form of a motion and the form of the substance in which the motion takes place, are not only interdependent, they are identical.

A certain percept, being a special form of motion in living brain substance, leaves in those cells in which it takes place, such vestiges as to produce a disposition adapted not only to receive the same or similar percepts, but even to reproduce that percept spontaneously, if the cells, nourished by the blood-circulation, are stimulated into activity through some inner process by association. This disposition (called by Hering *Stimmung*, which is produced by the special memory of organized matter), becomes stronger by repetition and thus imparts more and more stability to that special form.

Physiologically considered, percepts and concepts are very complicated structures which in their associations may resemble a kind of three-dimensional network, showing interlacings of innumerable star-shaped knots, the threads of which interradiate and combine the various sensory percepts belonging to the same idea. But for the sake of simplicity let us suppose that perceptions and conceptions grew in a brain like cells and groups of cells simply; they would naturally and mechanically arrange themselves in systematic order. One of the first steps in the evolution of living matter is that of giving stability to its outer form by enveloping itself in a membrane. Form, as we understand the term, is not only the outside shape, but also the inner disposition and arrangement of atoms. However, for the sake of simplicity again, and as a matter of crude illustration, let us for a moment use the membranes of cells as an example of their forms. The membranes of cells are also organic substance and their material particles are constantly changing. Nevertheless, they possess a relative stability which represents the shape of the cells, *i. e.*, their outer form. If we would take out of such a brain the living substance without destroying the membranes in which the cells have enveloped themselves, it would afford an aspect of divisions and subdivisions not unlike that of the departments, shelves, and pigeon holes of a library from which the books are removed, and we would have an anatomical representation of a system of formal thought.

It is understood that this explanation is a simile only to show that form grows *pari passu* with its substance, and mere form, if abstracted from its substance, is, for purposes of thought, by no means valueless; it is of greatest importance for a proper orientation among the enormous mass of sense-perceptions that crowd upon the mind.

An animal and a man may have the very same sensory impressions; their brain substance consists of the same combinations of nervous matter; sensations (the basis of all mental activity) are produced by the same kind of organs and in the same way. Yet there is a difference of form between the animal and the human brain in so far as the many different impressions of same percepts have not yet attained in the animal brain that stability and unity which they possess in the human brain. In the human brain the subdivisions are more marked, the furrows are deeper as well as more numerous; and from recent investigations we know that every class of same perceptions has acquired an additional and closely associated brain structure which embodies its name.* The whole group of certain percepts together with their name represents what in logical and psychological language is called a concept.

Let us now suppose that the chief librarian of the library of our brains for the sake of arranging a catalogue takes an inventory of all the books arranged in the different alcoves. He would find the same principle of arrangement applied everywhere. The different alcoves would have separate departments and these again would be found to possess subdivisions. This kind of arrangement, which, as we stated above, grew naturally, became first apparent when the process of naming took place. Many different names were conceived in our consciousness to be special kinds of one general kind so that they together formed one system of ideas. Logicians call it *genera* and *species*.

* Compare the map and explanations of the human brain in *Der Mensch*, by Dr. Johannes Ranke, Vol. I, p. 530 et seq. The chapter, "*Lokalisation in der Grauen Grosshirnrinde*," explains Broca's, Hitzig's, and Fritsch's investigations. It takes into consideration the arguments proposed by adversaries of the localization theory (Goltz, etc.), and adopts Exner's view which, it appears, reconciles seemingly irreconcilable principles.

The librarian (we now suppose) arranges an office (perhaps for the purpose of reference) in which a general plan of the whole library can be found. This reference room contains no books. The visitor finds there no substantial information; the information to be gained there is purely formal and serves the purpose to find one's way easier in the many different departments of the alcoves. This reference room in our brain is called logical ability, or mathematical reasoning, or calculation, and we need not say that its establishment marks another important step in the development of reason; it is formal thought. It is the beginning of scientific thought by the help of which we gain information about the methodical arrangement of our conceptions. Logic does not create order and system in our brain, but it makes us conscious of the order that naturally grew in our mind.

The difference between the library and our mind is, that in a library the shelves have been put up before the books were stored, but in our brains the different notions form (or rather grow) their own categories. The notions of our minds are like living books that build their own shelves and pigeon-holes, similar to the way in which cellulizing protoplasm covers itself spontaneously with a membrane. If we abstract from the protoplasm, which constitutes the

contents of cells, we retain the empty membranes, and if we abstract from the sensory material of percepts and concepts, we retain their mere forms, which, reduced to rule, are called formal thought, *i. e.*, arithmetic, mathematics, mechanics, and logic.

Knowledge of objects has been gained by sensory impressions, but knowledge of logic can be acquired only by a process of self-observation. It is a kind of internal experience which is quite different from that of external experience; the latter takes place by, and can never dispense with, the instrumentality of the senses. If the rules of pure logic are to be established, we must carefully exclude from this process of inner self-contemplation the interference of the senses, for it is only the form of things, and thoughts, and motions, with which in purely formal thought we are concerned. The importance of these forms becomes at once apparent if we bear in mind that as they are in one case they must be in all others also. The rules by which we generalize our knowledge of formal conditions (of mathematics, arithmetic, logic and mechanics) possess universality and necessity.

The process of scientific enquiry will be seen to be everywhere the same. Science classifies sensory experience according to the categories of formal thought. In so far as we succeed in reducing the data of a certain subject to mechanical, mathematical, arithmetical, or logical principles, we solve its problems and recognize why the different phenomena which are subject to our special enquiry *must* be such as they are. Science traces necessity everywhere; and science can do so only by the help of the formal truths, which, holding good for all imaginable cases, show single instances under the aspect of universal and irrefragable rules.

III.

THE ORDER OF NATURE.

FORMAL thought represents the mere laws of thought in their abstractness, and has been acquired by abstraction. The mere forms of thought exhibit a wonderful regularity which excites our admiration all the more from the great advantages man derives from it. This regularity of formal thought, which is expressed in all logical laws, arithmetical calculations, and in all mathematical conceptions, has naturally grown in our mind as the psychical expression of a physical regularity in the arrangement of the various brain-structures and their combinations.

The arrangement of brain-structures in certain regular forms has been effected in accordance with the same laws that govern the development of forms generally. Therefore, the problem "why man happens to be a logical and reasonable being," turns out to be the same as that "why are the cells in plants arranged in a certain order?" and as that "why do crystals possess a certain regularity?" The problem common in these three questions is: "Why is the world a cosmos (an orderly arranged whole) and not a chaos?" It is the same problem that Kant proposed when he asked: "How is Nature possible at all?"

The problem has been solved differently by different philosophers, and there is no mark that better characterizes a philosophy than the answer it proposes as an explanation of the order of the world. Supernaturalism says: The order of the world is due to a special ukase of a Creator. Materialism, on the

other hand, declares that order is the product of chance. Both views have much more in common than appears at first sight. Materialism and supernaturalism are antagonistic and their explanations are irreconcilable. Nevertheless, both start from the same supposition which, from the monistic standpoint, appears to be erroneous: both are dualistic in so far as they consider the world as one thing, and order as another. Order, they declare, has been imposed upon the world either by a transcendent legislator or by a blind chance. Supernaturalism teaches that in the beginning there was *tohuvabhohu*, 'the earth was without form and void,' and materialism similarly begins the history of the world with chaos.

Theological dogmatists anthropomorphize God to such an extent that they compare him to a watchmaker, and the world to a watch. The order of the world, they imagine, has been fashioned to his designs. It is not in itself necessary, but posited by his will. It is necessary only in so far as his intention makes it so. On the other hand, materialistic thinkers similarly explain the order of the world, if not as the result of a wilful act, yet as the fortuitous outcome of blind chance. One of them expresses his opinion as follows: "The first elements, after testing every kind of position and production possible by their mutual unions, at length settled in the form and way they now present."

In opposition to both views, the monistic conception considers the world as a cosmos, *i. e.* an orderly arranged whole. Monism says: "The world and the phenomena of the world are orderly arranged, according to mechanical laws."

Consider how many billions of other combinations of the atoms in an amœba are possible, or at

least thinkable! And nature should have tried all these infinite possibilities, or part of them, before creating the amœba, and then the hydra, and then the worm, and so forth! Oh no! The order of the world is no hap-hazard effect, it is no fortuitous outcome of chaos. *There is no chaos and never has been a chaos.* Even in the gaseous nebula there is order and law, and it appears as chaos only in comparison to the more evolved state of a planetary system. Thus the barbaric stage of savage life appears to us as lacking in social order; and our present state of civilization, it is to be hoped, will appear to future generations as the chaos out of which their better arranged society emerged.

Kant says on this subject: "The aforementioned expositors of the mechanical theory of cosmic genesis (Epicurus, Leucippus, and Lucretius) derived every arrangement perceptible in the cosmic system from fortuitous accident, which caused the atoms so to hit together that they made up a well-ordered whole. Epicurus, indeed, was so presumptuous, as to require the atoms to swerve from their direct motion without any cause at all, in order to be able to meet one another. Every one of these philosophers carried this nonsensical principle so far, as to ascribe the origin of all animate creatures to this same blind concurrence of atoms, and actually derived reason from what is not reason (*Vernunft* from *Unvernunft*). In my system of science, on the contrary, I discover matter joined to certain necessary laws. In its complete dissolution and dispersion I see a beautiful and orderly whole naturally arising. This does not occur through accident or at hap-hazard, but it is seen that natural properties necessarily bring it about." Kant argues that this ne-

cessary order is a proof of the existence of God. We argue from our standpoint that this order is due to the laws of form. It can be ascertained and comprehended by an application of the laws of formal thought. This order produces, on the one hand, the *intelligibility* of the world and, on the other, the *intelligence* of rational beings. In its highest stage this order appears as a moral law to which rational beings voluntarily conform so as to be in unison with the whole cosmos. This order, we maintain, is immanent in the universe and, in fact, *it is God.* Human reason mirrors this order in the sentient brain of a living being and thus the sacred legend is justified in declaring that man has been created in the image of God.

The laws of order are omnipresent and eternal. The omnipresence and eternity of these laws does not denote transcendency, or unknowability, or supernaturalness. Nothing of the kind! It simply means that as they are in one case, so are they rigidly in all others. In their most simple shape, the laws of formal thought (logical, arithmetical, mathematical, etc. rules) are recognized as self-evident and necessary, so that we attribute to them absolute certainty and universality. The more complicated processes of higher algebra, higher mathematics, or highly involved logical ratiocinations, appear less absolute to those who are not familiar with abstract reasoning, but are after all just as absolute. We are, by reason of their complexity, liable to be easily mistaken, but, errors on our part excluded, they in themselves are quite as certain and universal, rigid and necessary, as those simple rules which are generally accepted as axioms.

Kant solves the problem "How is Nature possible at all?" in the following way. The highest or most

general laws of Nature, he argues, are within us and can be stated a priori, independent of sensory experience. He thinks it is a strange and wonderful fact that our formal thought (the rules of arithmetic, mathematics, logic, etc., which are a priori) agrees so precisely with the highest (i. e., the most general) laws of nature, which can be ascertained and verified a posteriori by experience. Kant sees only two ways of solution. Either the laws of pure reason, he says, have been gathered by experience from nature, or, on the contrary, the laws of nature have been deduced from our a priori rules. The former solution is impossible, since the formal sciences are proven to have been formulated with the exclusion of all sensory experience. "Therefore," says Kant, "the second solution only remains. Reason dictates its laws to Nature"; *i. e.* our reason is so constituted that it conceives everything in the forms of space, time, and the categories of pure reason. Space, time, and the categories are a part of the thinking subject, which cannot but think in these forms, and must thus transfer them to the objects. Our surroundings affect us by what we call sensory impressions. The sensory impressions are the raw material only from which the well-ordered whole of nature, as an object of science, is created by the synthetic faculty of reason. Reason with the help of formal thought shapes this intellectual world in our minds, which is, so to say, projected outside of ourselves into our surroundings.

Kant has taken into consideration two ways only. He overlooked the third and most obvious explanation. His explanation, therefore, will be seen to be one-sided and insufficient. The third possibility is that which has been propounded in the foregoing pages.

According to our explanation, the formal (the highest or most general) laws of Nature and the formal laws of thought are identical. Their agreement is not wonderful but inevitable as both are expressions of the forms of existence in general.

Kant's explanation is *one-sided*, because if the formal laws of Nature have been dictated by the thinking subject, it does not explain why the formal thought (our knowledge, a priori) is so precisely verified by experience. If we see, as it were, the order *into* nature, how is it that this imposition upon nature is not frustrated? Nature is by no means pliant to any fictitious dictation of subjective laws a priori. It frustrates incorrect a priori reasoning; but tallies with correct and exact calculations. Therefore we conclude, that the form of nature is the same as that of our reason. The forms of thought agree with the forms of existence for the reason that the forms of thought are only a special kind of the forms of existence.

Kant's explanation is, further, *insufficient;* it does not explain how formal thought originates. And this insufficiency of Kant's explanation, we believe, has given rise to many errors. This gap in Kant's philosophy, we think, has been the place in which mystical followers of Kant have been enabled to construct their ontological or supernatural illusions. The transcendental conceptions of pure reason have been declared by them to be of transcendent* origin. The opposition of John Stuart Mill and his school to Kant's conception of the a priori arose, as Mr. Mill confesses in his autobiography, from his considering the transcendental philosophy as an imposition of this kind—an imposition by which inveterate beliefs and deep-seated prejudices could be consecrated.

*We have repeatedly called the reader's attention to the difference Kant makes between transcendent (unknowable) and transcendental (formal).

According to our solution, the radical difference obtaining between formal and material (between what Kant defines as a priori and a posteriori) is not neglected; on the contrary, its fundamental importance is fully recognized and firmly established. The conception of necessity which is the basis of all science, has found its justification as attaching everywhere to form—the laws of form being everywhere the same. The order of the Universe is thus recognized as an immanent necessity. This necessity can be traced with the assistance of formal thought everywhere, as shaping or having shaped the forms of existence. The laws of form being the same everywhere, our reason can, if not properly dictate, as Kant says, yet inform us about the form of existence in the whole universe. The laws of formal thought being absolutely and universally applicable, are our guide which like the thread of Ariadne safely leads us through the labyrinth of the manifold sensory experiences. It is this method, and this is the only one, which frees philosophy of mysticism, be it the mysticism of supernaturalists or of agnostics.

IV.

THE BASIS OF THE ECONOMY OF THOUGHT.

MATHEMATICS, as still taught in our schools, is, after the example of Euclid, unfortunately constructed on axioms. The introduction of axioms still gives to mathematics an air of mysteriousness which should be absent in this most reliable and well established sci-

ence. This doctrinal method of teaching mathematics, by starting from authoritative axioms, which have to be accepted on good faith, is unphilosophical and should give place to a more rational method. It induced Schopenhauer to declare that the whole science, being based upon non-proven truths, remains non-proven. He considers mathematical certainty to be ultimately a part of intuition and thus reaches a point where mysticism can have full play.

Hermann Grassmann in his "theory of extension" (*Ausdehnungslehre*) avoids the faults of Euclid's method. Grassmann throws a new light upon Kant's idea of the a priori by formulating a science of pure mathematics. Our space has three dimensions (*Ausdehnungen*, or extensions), and plane geometry is a mathematics of two dimensions. Grassmann's idea was, to propound mathematics as it would appear if absolutely abstracted from dimensions of any number. This science of pure mathematics must be the most abstract formal thought.*

The "theory of forms in general" (*Allgemeine Formenlehre*), Grassmann says, should precede all the special branches of mathematics. By a theory of forms in general he understands "that series of truths which

*The ingenious attempts of Bolyai and the Russian geometer Lobatschewsky (discussed in C. F. Gauss's 'Briefwechsel mit Schumacher,' Vol. II. pp. 268 to 271), to erect a geometrical system which would be independent of the Euclidian axioms in regard to parallels, and Riemann's meritorious essay "On The Hypotheses Of Geometry," have called the attention of mathematicians and scientists to a remarkable problem which finds its natural and most simple solution in Grassmann's theory of pure mathematics. Hamilton's method of Quaternions is contained in it also, since Grassmann takes into account the length *and direction* of lines. For brief information on the subject see Helmholtz's lucid sketch *Ueber die Thatsachen, die der Geometrie zu Grunde liegen* (Upon the Facts that lie at the Basis of Geometry), J. B. Stallo, "The Concepts and Theories of Modern Physics," pp. 208 seqq., and 248 seqq., and compare also with Hermann Grassmann, *Ausdehnungslehre, Anhang* I. and III. pp. 273 seqq., and 277 seqq.

refers equally to all branches of mathematics and which presupposes only the general concepts of identity and difference, of combination and separation. * * Products of thought can originate in two ways, either by a simple creative act (that of positing) or by the double act of positing and combining. The product of the former kind is a constant form or magnitude in a narrower sense, that of the latter kind is a discrete form or a form of combination."

On the concepts of the identity and difference of posited acts of thought by mere combination and separation, Grassmann builds his magnificent structure of a theory of forms in general, of which arithmetic, geometry, algebra, mechanics, phoronomics, and logic appear to be applications only of special kinds. He is in need of no axioms whatever. The only postulates are such as these: Arithmetic is a system of first degree; plane geometry is a system of second degree; and space is a system of third degree. Plane geometry has two dimensions, and, therefore, if we have one point fixed, two magnitudes are required for the determination of any other point. Space has three dimensions, so that taking a fixed point three magnitudes are necessary for the determining of any other point. Colors, it appears, are another system of third degree; they can be reduced to three primary colors: red, orange, and blue. Accordingly three magnitudes are required for determining any kind of tint. A distinguished scientist has invented a method of graphic representation of colors by triangles.

We cannot have any intuitive conception of a space having four dimensions. Nevertheless, pure mathematics, being independent of dimensions, applies just as much to systems of four and more degrees as to the

actual space of three dimensions. The regularity of every system is fixed a priori by the elements posited for that system. The elements, positing themselves or being posited by us according to the rigid rule of strict consistency, will necessarily form a regular and orderly arranged system. We can therefore state with absolute precision all the formal laws by which bodies of four or five dimensions, if they existed, would be governed.*

The chief difference between the numbers of arithmetic, geometrical planes, mathematical space,

* As an example we may use the instance, that the product of two magnitudes in a system of second degree can be algebraically expressed by

$$(a + b)^2 = a^2 + 2ab + b^2,$$

in a system of third degree, by

$$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

in a system of fourth degree, by

$$(a + b)^4 = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4.$$

Accordingly, a cube or any parallelopipedon which is the product of two magnitudes consists of eight tri-dimensional parts. This fact cannot only be proven a priori by mathematical or algebraical demonstration of purely formal thought, it can be ascertained by experience also. A cube that is cut in all its three dimensions, according to the ratio of a + b, will afford an example, and a body formed by two magnitudes (a + b) in four dimensions, if it were possible, would consist of the following 16 four-dimensional parts:

1. A regular body which in all four directions measures a ($= a^4$).

2. Another regular body which in all four directions measures b ($= b^4$).

3. Four bodies which in three dimensions measure a ($= a^3$), and in one b

4. Four bodies which in three dimensions measure b ($= b^3$), and in one a.

5) Six bodies which in two dimensions measure a ($= a^2$), and in two b ($= b^2$).

on the one hand, and Grassmann's systems of 1, 2, 3, or n dimensions on the other, is, that numbers, planes, and actual space are accepted as given; they are the data of arithmetic, geometry, and mathematics, while the systems constructed by Grassmann's "theory of forms in general" are conceived as products of thought. They are posited by a progress of thought and can be considered as data only if their parts, once posited, are further used as such for combinations among themselves.

It is obvious that the only condition of all kinds of such systems of formal thought is *consistency*. Truth with regard to our knowledge of reality is the agreement of our concepts with the objects represented; but truth in the domain of pure formal thought is the agreement of all posited forms of one and the same system among each other. This consistency is the basis of all law, regularity, and order; and whatever system of forms may be selected, its rules and theorems will be developed by our mind with the same wonderful harmony and precision as can be observed in mathematics, arithmetic, logic, and mechanics. Accordingly, if the world were otherwise than it is, if space had only two, or if it had four dimensions, the laws of the world would be otherwise, but none the less regular than at present—they would be strictly *gesetzmässig, i. e.*, conforming to, and explainable by, law.

Consistency must be considered in the empire of form as the counterpart of inertia* in the realm of matter. So long as nothing interferes to produce a change,

* Inertia in German is sometimes called *Trägheit*, sometimes *Beharrung*. *Trägheit* is the literal translation of inertia; it is a negative term which denotes the non-appearance of new energy, or motion, or activity. *Beharrung* is the better term; it affords a positive expression for "inertia," denoting the unchanged continuance of the energy in existence.

everything will remain as it is. Consistency therefore, the very root of order, from which all order of form in every possible system of forms finds its explanation, is the natural state. Consistency like the law of inertia and the law of identity explains itself. Wherever we meet with it, it need not be accounted for; an explanation becomes necessary only where consistency is lacking. From this consideration it is apparent that to whatever system the form of reality belonged, it could in no case be devoid of order. The world could not be a chaos, but of necessity must be a cosmos.

Grassmann's theory of 'forms in general' throws a new light upon Kant's doctrine of the a priori, since it exhibits a science of pure form in its most generalized abstractness. Thus the a priori has lost the last vestige of mystery and we can easily understand how the cosmical order is due to the formal laws of nature. While Kant's reasoning has been correct in the main, it is apparent that real space is not quite so purely formal as he imagined. A system of form of the third degree can be posited a priori by formal thought; but the fact that real space is such a system of the third degree can be ascertained by experience only.

We have used the word order in the sense of objective regularity which of necessity results from a consistency of form throughout one and the same system. This regularity of forms enables us to think many samenesses by one idea and thus makes an economy of thought possible, which as Ernst Mach declares is the characteristic feature of science. Ernst Mach (who I must suppose has attained to his ideas quite independently of Grassmann, although there is no doubt that both have been strongly influenced by Kant), points out, by a happy instinct as it were, the

most practical application of the theory of formal thought in general.

The regularity of form being repeated in the physiological arrangement of the nervous cells and fibres in our brain, produces in man an economy of feeling and thinking which the more it is realized and practiced, gives him the greater power over nature.

V.

CONCLUSION.

ALTHOUGH Kant's Transcendental Idealism cannot be considered as a final solution of the basic problem of philosophy, it nevertheless pursues the right method and has thus actually led us to a solution which, we hope, will in time be recognized as final. In Kant's time, it seemed as if the key to the mysteries of cosmic order should be sought for in nature's manifestations outside of the human mind. Kant, a second Copernicus, reversed the whole situation and pointed out that the key to the problem: "How is nature possible at all?" is to be found in the human mind. And yet the natural sciences, inquiring into the secrets of nature by the observation of natural phenomena, were after all not on a wrong track. Kant and the natural sciences seemed to exclude each other, but they were complementary. Schiller who in so many respects fore-felt and fore-told future events in the prophetic spirit of his poetry, said in one of his Xenions, referring to Transcendental Philosophy and Natural Science:

"Both have to travel their ways, though the one should not know of the other.
Each one must wander on straight, and in the end they will meet."

Two truths may at first appear contradictory,

though they are not. Let us not distort the one for the sake of the other, but let each be presented without regard to the other, and let every point of divergency be brought out fully. Theory and practice, formal thought and experience, the thinker and observer, will at last agree better if they boldly take the consequences of their views and combat those of the other. About the relation of transcendental philosophy to natural science in his time, Schiller said:

> "Enmity be between both, your alliance would not be in time yet.
> Though you may separate now, Truth will be found by your search."

There has been enmity enough between philosophy and natural science. Philosophers looked with scorn upon the specialists who confined their labors to narrow circles, and scientists, confident of their positive results, smiled about the phantastic dreams of theoretic speculations. However, in the progress of time, philosophers learned to prize the valuable researches of natural science, and the scientists felt the necessity of a philosophical basis for their investigations and methods of investigation. At present the want of a close contact between philosophy and the sciences is a fact that is freely acknowledged by both, philosophers and scientists.

In Kant's and in Schiller's time an alliance between philosophy and natural science would have been premature. How many futile attempts have been made in the mean time! Fichte, Schelling, Hegel, and Schopenhauer in Germany, the two Mills and Herbert Spencer in England, Auguste Comte in France, have appeared with their systems, partly opposing, partly repeating Kantian ideas in other and original ways of presentation, partly combating his very method, partly popularizing, and at the same time opposing his views.

But none of them (not even Comte*) succeeded in creating a well-established positivism that could dispense with the mystical element altogether, whether it appear as the Transcendent, the Unknowable, or the Supernatural.

We have attempted in these essays on "Form and Formal Thought" to lay the cornerstone of such positivism, which, it is to be hoped, will prove to be the only true Monism, *i. e.*, a philosophy free from contradictions and in accordance with reality, thus offering a basis for a unitary and harmonious conception of the world.

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* Comte believed in the Unknowability of what he called "first and final causes," and considered only "the middle between them" accessible to cognition. He attempted to limit science to the positively knowable, but in so doing he left a non-knowable; he did not succeed in entirely freeing himself from mysticism—which after all is the primary object of all philosophy.

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